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(54) **Method and apparatus for making an apexed bead ring.**

(57) A method of making an apexed bead for a tire comprises the steps of providing a supply of rubber and a supply of bead wire. The rubber is extruded around at least one bead wire. An apex leaf projects from the rubber extruded around the bead wire to form a bead ribbon. The apex leaf extends in a direction laterally from the extent of the bead wire and is located between a pair of planes which are coextensive with opposite major side surfaces of a bead portion of the bead ribbon. The bead ribbon is wound spirally about itself to form a bead. Radially adjacent apex leafs contact one another to form an integral apex extending laterally from the bead.

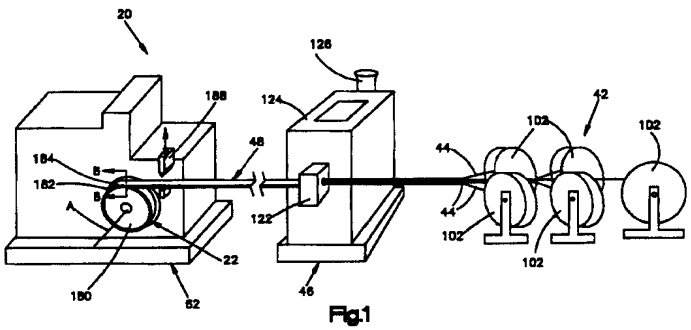

Fig.1

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BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates generally to a bead and apex for a vehicle tire. In particular, the present invention relates to a method and an apparatus for producing an integral bead and apex unit.

Description of the Prior Art

A bead and an apex for use in the construction of a vehicle tire are known. For example, U.S. Patent No. 1,809,106 discloses a bead ribbon having a bead portion with rubber located about parallel extending bead wires. A strip of rubber extends laterally outwardly and upwardly from one edge of the bead portion. The bead ribbon is wound spirally about itself a plurality of times to form a bead core ring. The bead core ring is placed around a carcass ply that is supported on a drum in a cylindrical form. The rubber strips extend axially inward along the carcass ply. The end of the carcass ply is then turned over the bead core ring. The assembly is then removed from the drum. When the assembly is shaped into its a toroidal form of a finished tire, the entire bead core ring is turned 90 degrees. The agglomeration of rubber formed by the rubber strips extend from the same surface of the bead portion that the rubber strips extended from originally. However, the agglomeration now forms a radially oriented apex.

U.S. Patent No. 4,168,193 discloses forming a wire bead ring. The bead ring is then placed in a mold. A cavity in the mold is injected with unvulcanized rubber to form a bead assembly with an apex portion extending substantially radially of the bead ring.

Bead and apex assemblies, such as those referenced above, have certain disadvantages. For example, a bead that is typically used today is substantially inextensible and is extremely difficult to turn through a 90 degree angle. In fact, modern radial tire building operations and machines have been adapted to accept the relatively inextensible beads which are not turned any appreciable amount during construction of a vehicle tire. Furthermore, injecting uncured rubber about a bead ring requires an additional manufacturing step, additional handling and additional capital equipment in the form of the injection molding apparatus. All of these additions can be costly to the forming of an apexed bead.

SUMMARY OF THE INVENTION

The present invention is directed to a method and apparatus for making an apexed bead for a vehicle tire. The method of making the apexed bead for a tire comprises the steps of providing a supply of rubber and a supply of bead wire. The rubber is extruded around at least one bead wire. An apex leaf projects from the rubber extruded around the bead wire to form an elongate and substantially continuous ribbon. The apex leaf extends in a lateral direction relative to the extent of the bead wire. The apex leaf is located between a pair of planes extending coextensively with a pair of respective major side surfaces of a bead portion of the bead ribbon. The bead ribbon is wound spirally at least once about itself to form a bead. Radially adjacent apex leafs contact each other to form an integral apex extending laterally from the bead.

The apparatus for forming the apexed bead includes a cylindrical surface for supporting the bead during a spiral winding operation. A frustoconical surface is located concentric with and axially adjacent to the cylindrical surface for supporting a radially extreme apex leaf. The frustoconical surface contacts the radial extreme apex leaf so radially adjacent apex leafs contact each other to form the apex.

BRIEF DESCRIPTION OF THE DRAWINGS

Further features of the present invention will become apparent to those skilled in the art to which the present invention relates from reading the following specification with reference to the accompanying drawings, in which:

Fig. 1 is a schematic view of an apparatus which is used for making an apexed bead;

Fig. 2 is an enlarged view of a portion of a bead extruder head of the apparatus in Fig. 1;

Fig 3. is a cross-sectional view of the extruder head in Fig. 2, taken approximately along line 3-3 in Fig. 2;

Fig. 4 is an end view of the extruder head in Fig. 3, taken along line 4-4 in Fig. 3;

Fig. 5 is a partial perspective view of a portion of a bead ribbon embodying the present invention;

Fig. 6 is a cross-sectional view of a portion of a specially shaped forming wheel of a bead ring winder in Fig. 1;

Fig. 7 is a cross-sectional view of a forming wheel of an alternate embodiment of the present invention;

Fig. 8 is a cross-sectional view of the forming wheel in Fig. 1, taken approximately along line 8-8 in Fig. 1, cooperating with several spirally wound bead ribbons to form the apexed bead;

Fig. 9 is a cross-sectional view of the forming wheel in Fig. 7 cooperating with several spirally

wound bead ribbons to form the apexed bead;

Fig. 10 is a cross-sectional view of a portion of a tire building machine and the apexed bead illustrating the axial location of the apex relative to the bead; and

Fig. 11 is a view of the tire building machine of Fig. 10 with parts in different positions and illustrating the changed location of the apex to a radial location relative to the bead.

DESCRIPTION OF PREFERRED EMBODIMENTS OF THE INVENTION

An apparatus 20 for making an apexed bead ring 22 is illustrated in Fig. 1. The bead making apparatus 20 includes a station 42 for delivering prepared bead wire 44 to a rubberizing station 46. The rubberizing station 46 deposits uncured rubber around the bead wires 44 and forms a bead ribbon 48. The term rubber as used herein is intended to include any natural or synthetic rubber or any combination thereof. The bead ribbon 48 is then guided to a bead ring winder 62. The bead ring winder 62 spirally winds several layers of bead ribbon 48 (Figs. 8 and 9) about itself to form the hoop-like apexed bead ring 22. The finished apexed bead ring 22 is suitable for use in the construction of a vehicle tire.

The bead wire delivery station 42 includes reels 102 supported for rotation to deliver individual bead wires 44 to the rubberizing station 46. The bead wire 44 is preferably steel, but any suitable material may be used to form a substantially inextensible bead ribbon 48. In a preferred embodiment of the invention, five reels 102 of bead wire 44 are illustrated. However, it will be apparent that any suitable number of reels 102 and bead wire 44 may be used for the particular configuration of bead ribbon 48 desired.

The bead wires 44 are continuously pulled into the rubberizing station 46 in a substantially parallel, equally spaced and planar relationship. The bead wires 44 extend in the longitudinal direction to carry load in the substantially continuous and elongate bead ribbon 48.

The rubberizing station 46 includes an extruder head 122, a feeding station 124, and a hopper 126. The hopper 126 receives uncured rubber stock and supplies the rubber stock to the feeding station 124. The feeding station 124 mixes the rubber stock and delivers the rubber to the extruder head 122 (Fig. 2).

Uncured rubber 142 (Fig. 3) is deposited around the bead wires 44 as the bead wires are pulled through the extruder head 122. After the rubber 142 is deposited around the bead wires 44, a die portion 144 (Fig. 4) of the extruder head 122 forms the rubberized bead ribbon 48 into a predetermined shape, as illustrated in Fig. 5.

The bead ribbon 48 includes a bead portion 162 (Fig. 5) which contains the rubberized bead wires 44 and functions as a load carrying portion. An apex leaf 164 extends axially or laterally of the bead wires 44 from the bead portion 162. The apex leaf 164 is formed integrally as one piece with the bead portion 162. In the preferred embodiment, the apex leaf 164 has a substantially triangular cross-section taken in a plane extending transverse of the extent of the bead wires 44. It will be apparent that the cross-sectional shape of the apex leaf 164 may be something other than triangular. For example, any cross-sectional shape may be used and is dependent upon the desired shape of the finished apex on the apexed bead ring 22, as is described below.

The apex leaf 164 is shown to have a pair of equal length legs 166 which are straight. However, it will be apparent that the exact length and shape of each leg 166 would depend on the exact application and final configuration of the apexed bead ring 22 that is desired. The apex leaf 164 extends from the bead portion 162 between a pair of planes P1, P2 which are coextensive with and define the limits of opposite major side surfaces 168 of the bead portion. The major side surfaces 168 are defined as the surfaces of the bead portion 164 having a transverse dimension (width W) greater than the transverse dimension (thickness T) of the minor side surfaces or edges 170 of the bead portion 162.

Thus, the one piece bead ribbon 48 is formed in a single operation having a bead portion 162 and an apex leaf 164. No additional capital equipment is required to form the bead ribbon 48. Existing equipment can be modified easily to produce the bead ribbon 48.

In the preferred embodiment of the invention, the rubber in the bead portion 162 and in the apex leaf 164 are from the same stock and have substantially the same durometer hardness. In an alternate embodiment the apex leaf 164 may be made from a rubber having a higher durometer than the durometer of the rubber in the bead portion 162. This may be accomplished by the higher durometer rubber being separately delivered to the extruder head 122 by another or a modified feeding station 124.

After the bead ribbon 48 exits the rubberizing station 46 it may be cut off and stored for future use. Preferably, however, the bead ribbon 48 is directed to the bead ring winder 62 where the bead ribbon is spirally wound into the finished hoop-like apexed bead ring 22, as illustrated in Fig. 8. Typically, the bead ribbon 48 will pass between pull drums (not shown) and a through festooner (not shown), both of which are located between the

rubberizing station 46 and the bead ring winder 62.

The bead ring winder 62 includes a specially shaped forming wheel 180, as illustrated in Figs. 6 or 7 which receives and supports the bead ribbon 48 to shape the finished apexed bead ring 22. In the preferred embodiment, a cylindrical surface 182 (Figs. 6 and 8) receives and supports the bead portion 162 of the bead ribbon 48 to form a bead 84. The forming wheel 180 is rotatable about its longitudinal central axis A. The forming wheel 180 is driven to rotate a plurality of revolutions in order to spirally wind the bead ribbon 48 about itself an appropriate number of predetermined times. Spiral winding as used herein means the buildup of bead ribbon 48 substantially only in the radial direction relative to the axis A.

An inclined surface 184 of the forming wheel 180 engages the radially innermost apex leaf 164a. The inclined surface 184 preferably is frustoconical. The inclined surface 184 forces the innermost apex leaf 164a radially outward of the axis A. Upon a subsequent spiral wind of the bead ribbon 48, it will be apparent that the next radially outward apex leaf 164b will be deposited on the innermost apex leaf 164a to form an apex 86 extending laterally of the bead 84. The winding will continue until the desired finished shape of the apexed bead ring 22 is attained. The finished shape of the apex 86 is preferably substantially triangular in cross-section, taken in a plane transverse to the bead wires 44. It will be apparent that the apex 86 may be formed in other shaped.

The tackiness of the external surfaces of the bead ribbon 48 retain the parts of the apexed bead ring 22 in the desired hoop-like shape after the apexed bead ring is removed from the forming wheel 180. It will be apparent that the inclined surface 184 may have another shape other than frustoconical, depending on the desired shape of the finished apex 86 of the apexed bead ring 22. For example, the inclined surface 184 may be cup-shaped if a curved surface on the apex 86 is desired. As is known, an apex is used to space apart portions of sheet material used in tire construction as the sheet material is turned around a bead.

Once the desired number of revolutions of the forming wheel 180 have been accomplished, for example four revolutions in the illustrated embodiment, the finished apexed bead ring 22 having an integral apex 86 extending substantially axially or laterally from the bead 84 is provided. Once the desired number of layers of the bead ribbon 48 has been established on the forming wheel 180, the bead ribbon 48 is severed by a cut-off apparatus 188 (Fig. 1). The apexed bead ring 22 is then removed from the forming wheel 180 by moving the apexed bead axially to the left as viewed in Fig. 8. It will be apparent that the angle and length that the apex 86 extends from the bead 84 can be changed. For example, the angle of the apex 86 can be changed by changing the angle on the surface 184 of the forming wheel 180. The length of the apex 86 can be changed by providing a longer apex leaf 164 on the bead ribbon 48.

In order to start making a subsequent apexed bead ring 22, the newly cut leading edge of the bead ribbon 48 is placed on the forming wheel 180. The tackiness of the contacting surface of the bead ribbon 48 on the forming wheel 180 is sufficient so that friction between the bead ribbon and the forming wheel pulls the bead ribbon onto the forming wheel during rotation of the forming wheel.

An alternate embodiment of the present invention is illustrated in Figs. 7 and 9. Fig. 7 illustrates a forming wheel made 202 from two parts. The forming wheel 202 includes a cylindrical surface 204 for supporting the bead portion 162 of the bead ribbon 48. An inclined surface 206 is provided and is movable axially relative to the cylindrical surface 204. The inclined surface 206 is preferably frustoconical. The surfaces 204 and 206 are concentric and driven rotatably about the axis A, in the same manner that the forming wheel 180 described above is driven, to spirally wind successive layers of bead ribbon 48 about itself to form a finished apexed bead ring 22, as illustrated in Fig. 9.

After the desired number of layers of the bead ribbon 48 have been deposited on the surfaces 204,206, the inclined surface 206 is moved axially to the right as viewed in Fig. 9 an appropriate amount. The appropriate amount is at least slightly larger than the width of the apexed bead ring 22. The apexed bead ring 22 can be moved axially off the surface 204 and may then be radially moved between the surfaces 204 and 206. It will be apparent that the inclined surface 206 is supported for rotation from the right side as viewed in Fig. 9 whereas the cylindrical surface 204 is supported for rotation from the left side as viewed in Fig. 9 to allow the apexed bead ring 22 to be removed from the forming wheel 202.

After the apex bead ring 22 has been formed, it is a substantially circumferentially inextensible hoop-like member and is usable in a tire building operation. A machine used for a first stage radial tire building operation includes a drum end 302 (Fig. 10) which is radially expandable and contractable. The drum end 302 is illustrated in Fig. 10 in its contracted position and supports an innerliner 304 and a carcass ply layer 306. The apexed bead ring 22 is placed radially about the carcass ply layer 306, as illustrated in Fig. 10. The apexed bead ring 22 is positioned so that the apex 86 is located to extend from an axially surface or edge of

the bead 84. The apex 86 is positioned in an unconventional orientation from the apexes of the prior art.

During the first stage operation, the drum end 302 is expanded radially outward to the position illustrated in Fig. 11. During this expansion of the drum end 302, the apex 86 of the apexed bead ring 22 is forced to move or "flow" because it is made of a relatively soft rubber material. The apex 86 moves from an axial or lateral orientation relative to the bead 84 into a radial orientation relative to the bead so that the apex now contacts and extends from a radial outermost surface or edge of the bead. Some movement or "flow" of the apex 86 may occur in subsequent operations as well, for example during a second stage building operation or during curing. It is important to note that the bead 84 of the apexed bead ring 22 has not turned at all during the tire build operation. For example, in Fig. 10 the bead 84 is illustrated as having four layers of bead ribbon 48. Each layer of bead ribbon 48 has five bead wires 44. In Fig. 11 it will be noted that the four layers of bead ribbon 48 in the bead 84 have not reoriented. Specifically, the bead 84 has not turned through a 90° angle.

The outer edge or end of the carcass ply layer 306 and of the inner liner 304 are turned over the apexed bead ring 22, as is known, to form a cylindrical assembly for use during a second stage tire building operation. The tackiness of the layers 304,306 and the apexed bead ring 22 allow the parts of the assembly to maintain their relative positions throughout subsequent operations that will be performed before the tire is cured.

From the above description of preferred embodiments of the invention, those skilled in the art will perceive improvements, changes and modifications. Such improvements, changes and modifications within the skill of the art are intended to be covered by the appended claims.

Claims

1. A method of making an apexed bead ring for a tire, said method comprising the steps of:

providing a supply of uncured rubber;

providing a supply of bead wire;

depositing rubber around at least one bead wire;

forming an elongate bead ribbon which includes an apex leaf extending laterally from the rubber deposited around the bead wire and in which the apex leaf is located between a pair of planes defining the extent of major side surfaces of a bead portion of the bead ribbon;

spirally winding the bead ribbon on a forming wheel at least once about itself to form a bead; and

wherein said step of spirally winding further includes forming radially adjacent apex leafs into an integral apex extending laterally from the bead.

2. The method set forth in claim 1 wherein said step of forming radially adjacent apex leafs into an integral apex includes the step of locating an inclined surface concentric and radially of the apex leafs to contact a radially extreme apex leaf so radially adjacent apex leafs contact each other.

3. The method set forth in claim 2 wherein said step of locating an inclined surface includes providing the inclined surface with a frustoconical configuration.

4. The method set forth in claim 1 wherein said step of forming radially adjacent apex leafs into an integral apex further includes the step of shaping the integral apex into a triangular cross-section taken in a plane transverse to the extent of the bead wire.

5. The method set forth in claim 1 wherein said forming step is performed in an extruder head.

6. An apparatus comprising:

a substantially cylindrical surface for supporting a bead portion of a bead ribbon;

an inclined surface locatable adjacent to and concentric with said cylindrical surface for supporting an apex portion of the bead ribbon; and

means for rotating said cylindrical surface and said inclined surface in a cooperating manner to spirally wind the bead ribbon about itself to form an apexed bead ring and to establish a predetermined relationship between a bead and an apex of the apexed bead ring.

7. The apparatus set forth in claim 6 wherein said cylindrical surface and said inclined surface are fixedly attached to each other.

8. The apparatus set forth in claim 6 further including means for axially moving said inclined surface relative to said cylindrical surface.

9. The apparatus set forth in claim 6 wherein said inclined surface is frustoconical.

10. A method of making an apexed bead ring for a tire, said method comprising the steps of:

providing an elongate rubber bead ribbon having a wire reinforced bead portion and an apex leaf extending laterally from the bead

portion;

providing a rotatable forming wheel for receiving the bead ribbon, said forming wheel having a cylindrical surface and an inclined surface adjacent to and concentric with the cylindrical surface; and

rotating the forming wheel to spirally wind the bead ribbon about itself to form a bead from radially contacting bead portions and to form an apex from radially contacting apex leafs so the apex extends laterally from the bead.

11. The method set forth in claim 10 wherein said step of providing a forming wheel further includes providing the inclined surface with a substantially frustoconical shape.

12. The method set forth in claim 10 wherein said rotating step includes forming radially adjacent apex leafs into the apex having a triangular cross-section taken in a plane transverse to the extent of a wire in the bead portion.

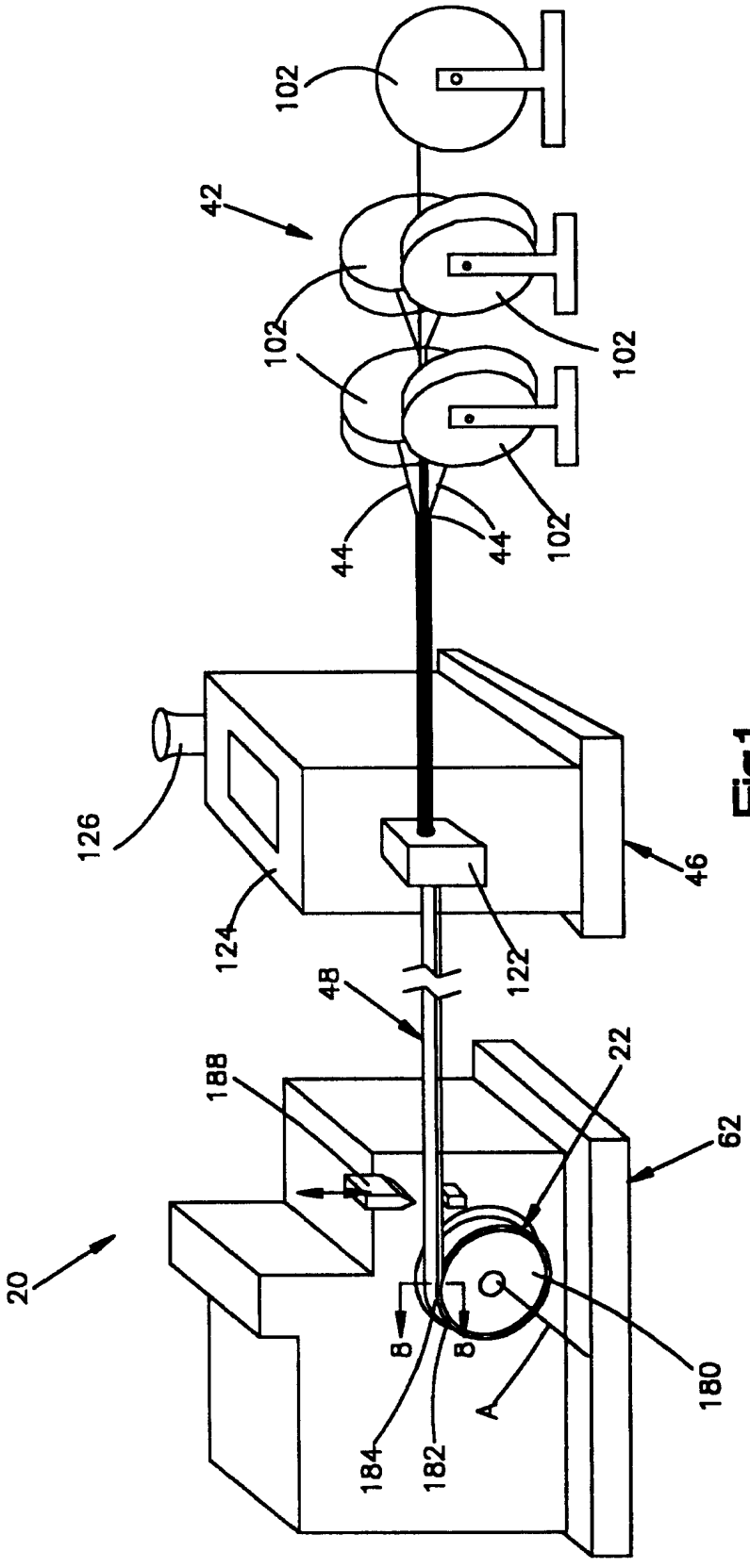
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Fig.1

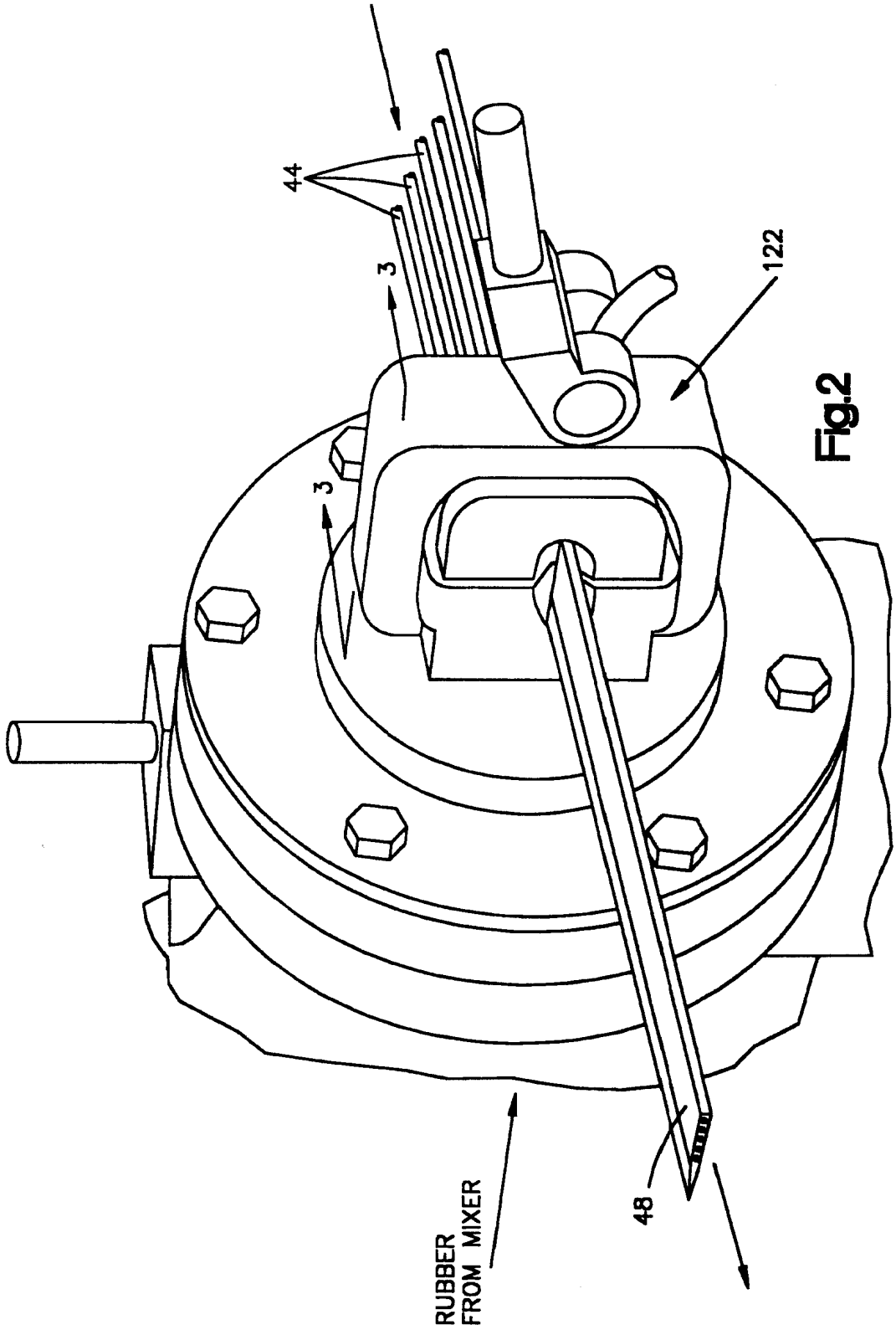

Fig.2

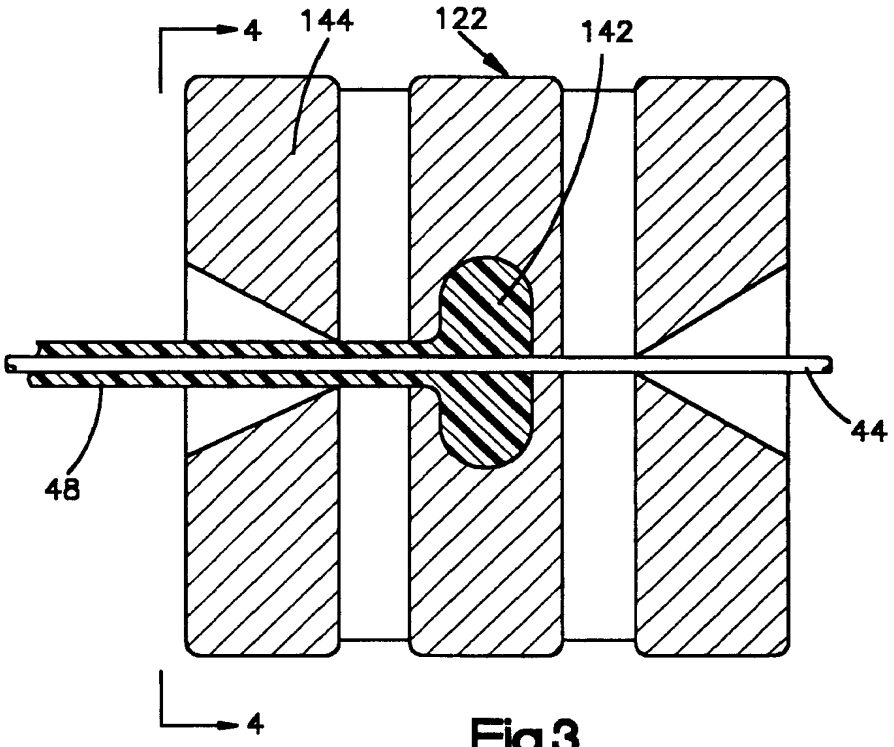

Fig.3

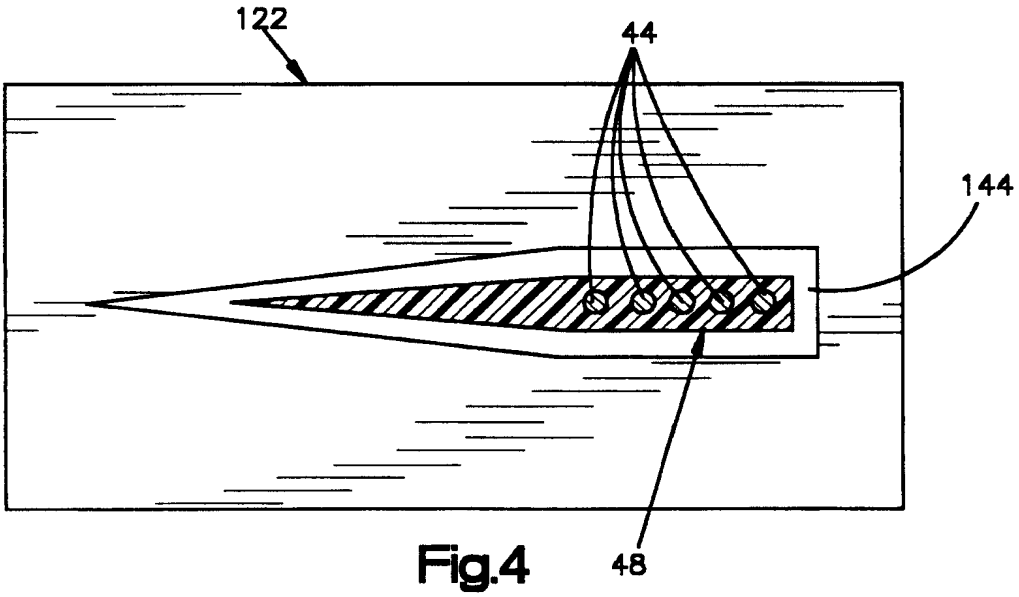

Fig.4

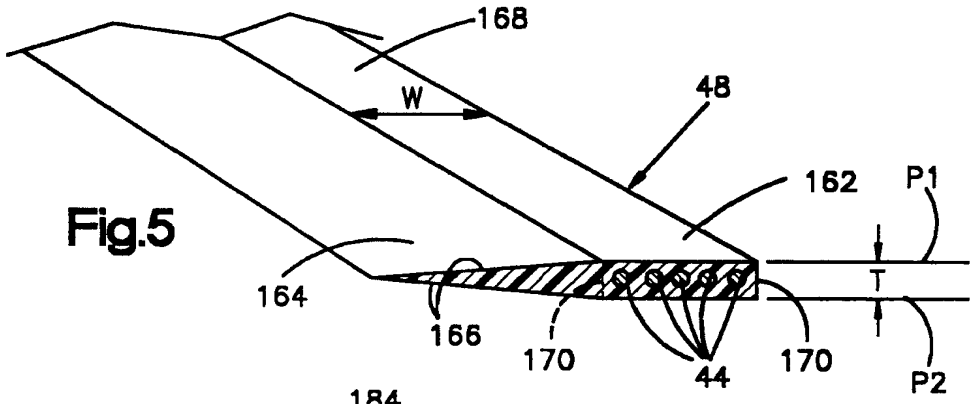

Fig.5

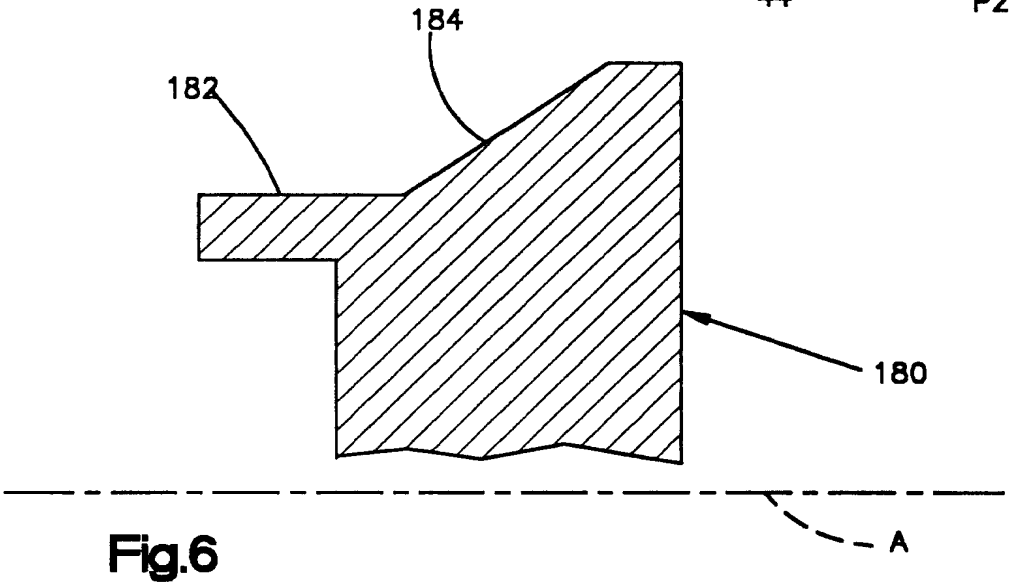

Fig.6

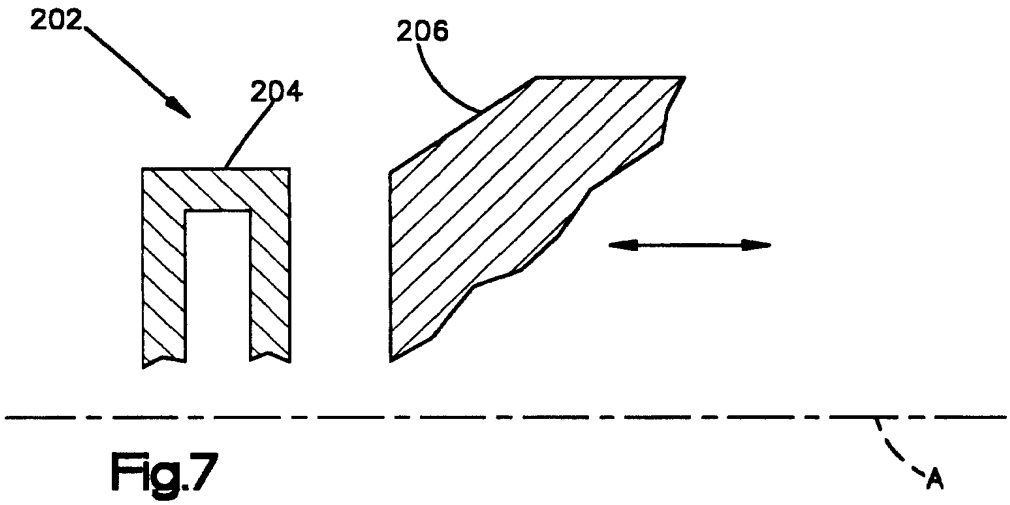

Fig.7

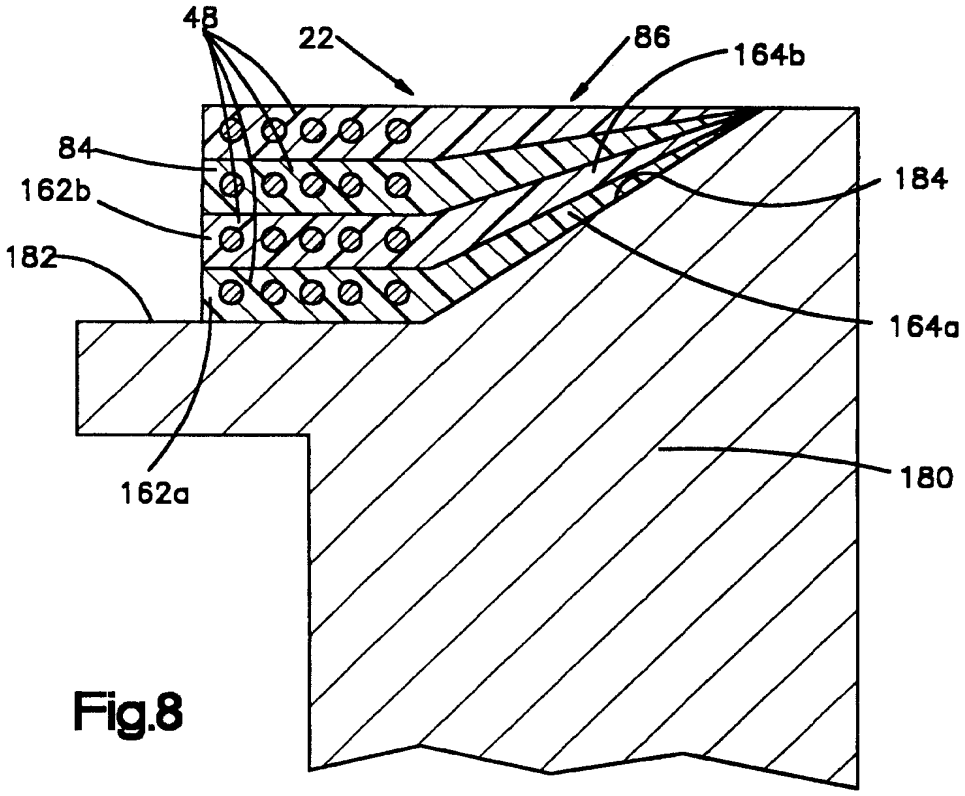

Fig.8

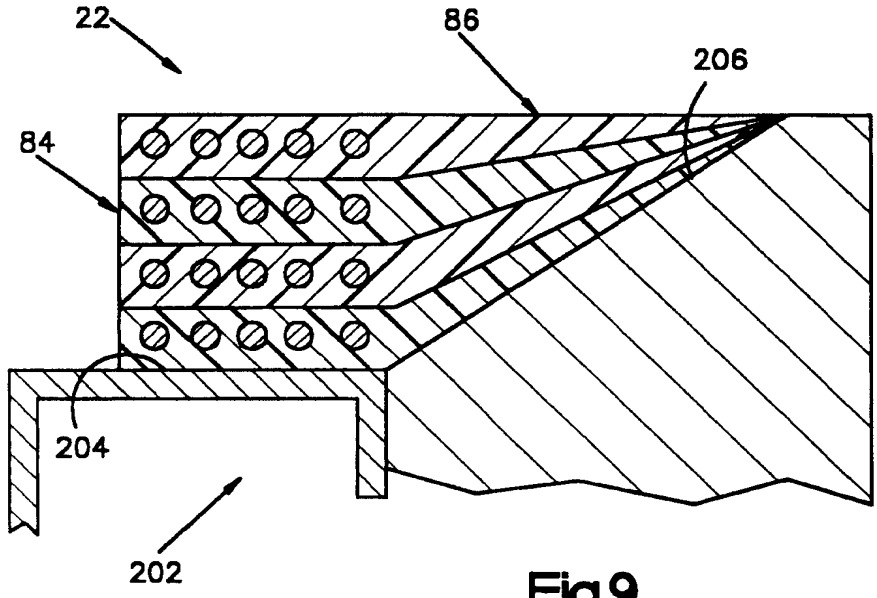

Fig.9

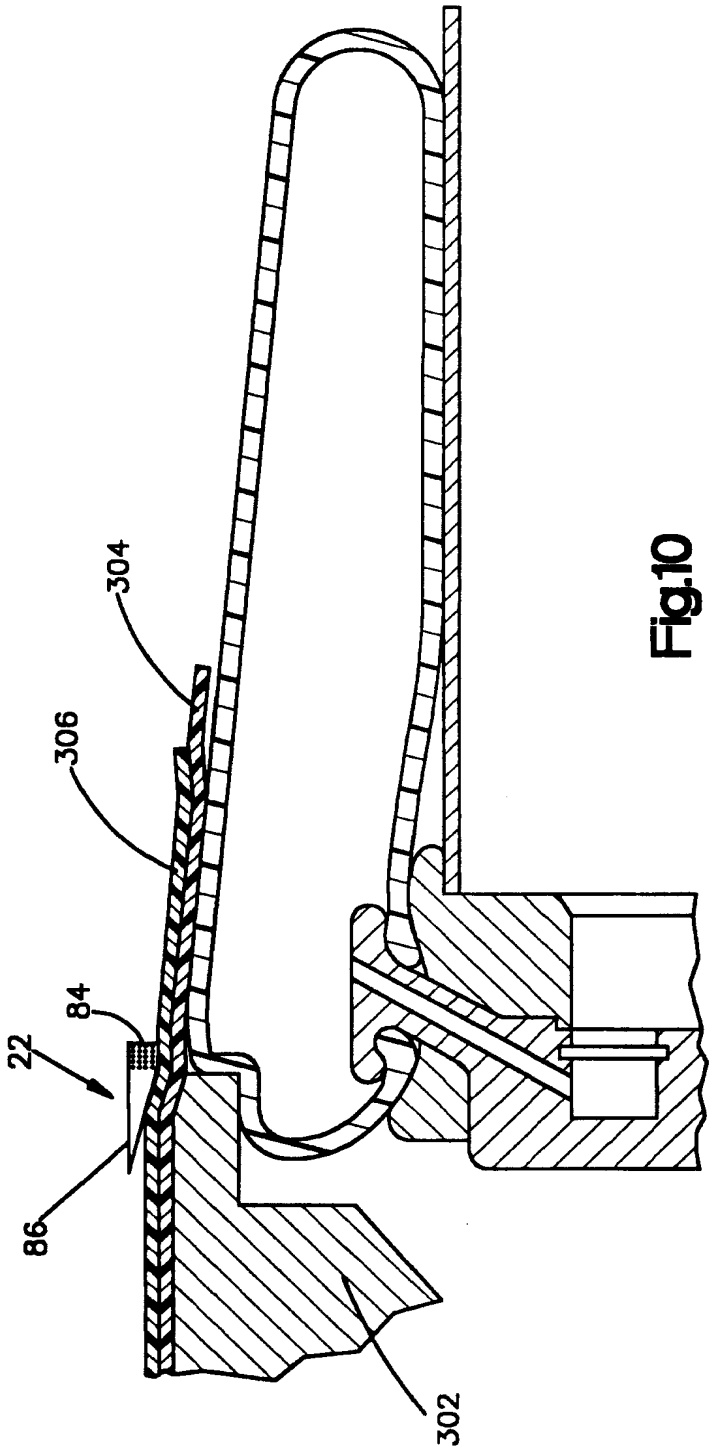

Fig.10

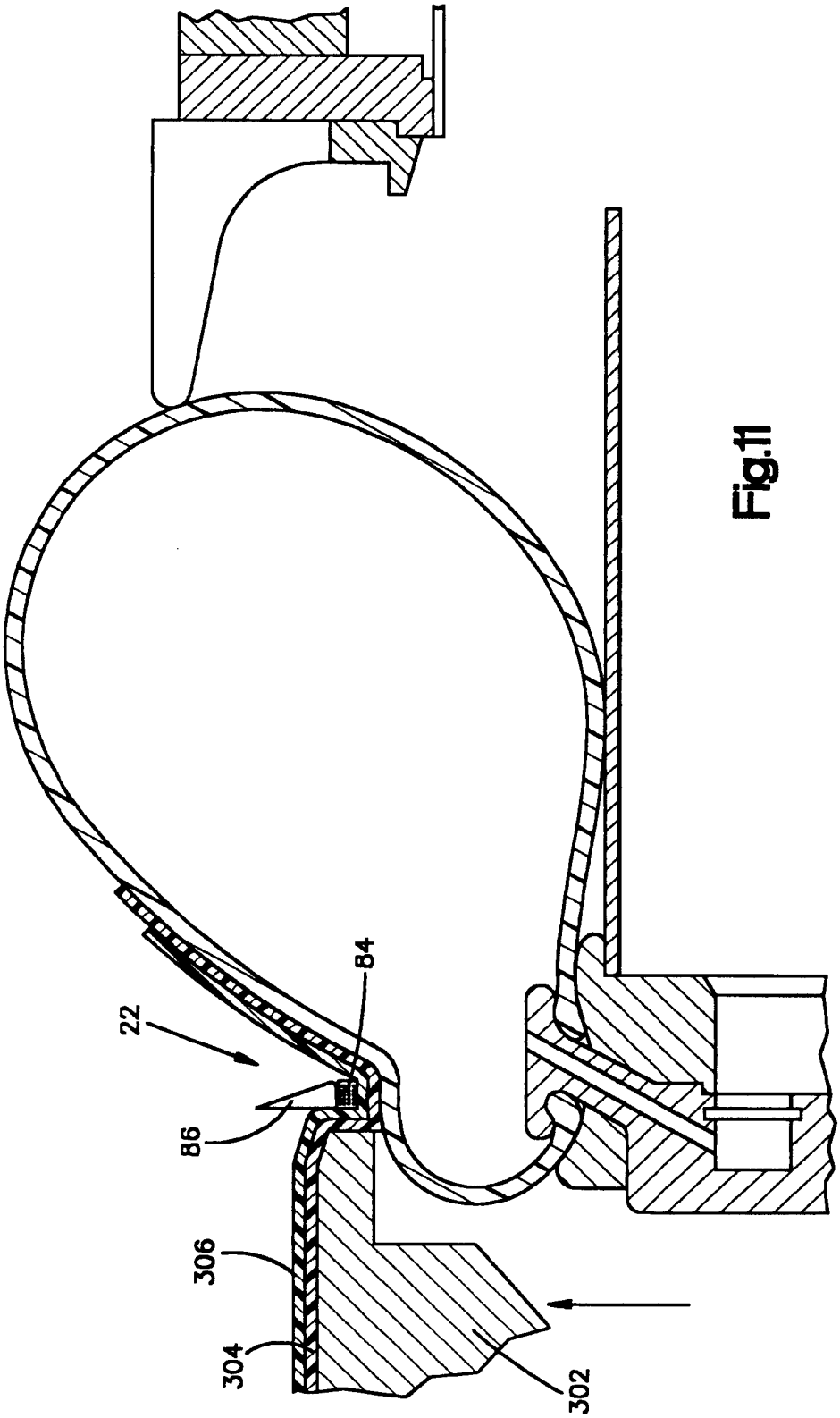

Fig.11